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Ontario
Ministry
of
Education

Policy Statement on Metrication

Conversion to the Metric System in Elementary and Secondary Schools of Ontario

Issued under the authority
of the Minister of Education,
The Honourable Thomas L. Wells

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Preamble

The Canadian government has stated that conversion to the metric system is desirable and inevitable. The Metric Commission in Ottawa has proposed 1980 as the target date for the completion of Canada's metric conversion program. It is evident that the curriculum in Ontario schools should now reflect a deliberate transition from the use of the imperial system of measures to the use of the metric system.

Metrication Policy

It is the policy of the Ontario Ministry of Education that:

1 the metric system become the principal system of measures in the curriculum of the elementary and secondary schools of the province;

2 metric conversion be implemented in the schools with the express intention of ensuring that programs of instruction become predominantly metric by June 1978;

3 metrication be applicable to all areas of the curriculum and that all measured quantities, wherever appropriate, be stated in metric units;

4 the units and symbols of the metric system taught in the schools conform to those of the International System of Units, known as SI;

5 metric conversion be accepted as an opportunity to reassess pedagogical approaches toward the topic of measurement as a whole; that students be provided with opportunities to acquire a practical and experiential knowledge of metric units through activities that involve comparing, estimating, measuring, and related problem-solving; and that teachers and students be encouraged to design and construct appropriate measuring devices to be used in conjunction with selected commercial equipment;

6 metric changes in the curriculum be co-ordinated with corresponding changes in industry and commerce;

7 metric conversion of learning materials in the schools be carried out on a pre-planned and gradual basis, with due consideration being given to the attrition, modification, and replacement of materials, as well as to the availability of new learning materials.

The remainder of this document consists of comments on these policy statements.

Comments on Metrication Policy

1 . . . that the metric system become the principal system of measures in the curriculum of the elementary and secondary schools of the province

1:1 The need to convert

At present, the imperial system of measures is still in wide use in Canadian society. However, the metric system is becoming increasingly common, and it is already evident that, well before the 1980's, athletic events, weather forecasts, highway signs, sizes of most consumer goods, and numerous other items will be expressed in metric units.

It is now imperative that the curriculum of the schools be redesigned to permit all students the opportunity to become familiar with common metric units as soon as possible. Many students will also require a knowledge of more specialized units that apply to particular disciplines.

1:2 Metric-imperial duality

Although the easiest way to learn the metric system is in an all-metric environment, this is impossible in a transitional phase. While the classroom can provide a metric orientation to measurement, the student will find that the world outside is, and for some years will be, concerned with imperial units. The quart of milk and pound of butter will be with us for some time. Adults will not automatically express their height in centimetres or their mass in kilograms. Public education will take time. Favourite recipes will not always be replaced willingly. Typewriters will continue to space letters by the inch and walls with 4-foot panels will last for years. The imperial system will not be phased out in a single magical metric M-day.

Imperial units – such as the inch, foot, and yard; pint, quart, and gallon; ounce, pound, and ton – may need to be mentioned in the classroom during the next few years while our society is merging into a metric environment. However, the list of imperial units used in the classroom should be kept as short as possible.

As teachers introduce metric conversion, they are not expected to abandon all reference to imperial units, but such units should not be used in situations in which they have become irrelevant to the common experiences of children and young people.

Metric and imperial units are to be treated as members of entirely different systems – not mixed within the same context. Mathematical conversions between metric and imperial units are to be avoided in the classroom wherever possible.

1:3 Introducing metric units

Metrication is not restricted to the formal context of the curriculum. The changeover, with its many implications, will affect everyone associated with the process of education.

Principals and teachers are already concerned with the need to revise the curriculum so that all students, both elementary and secondary, may become familiar, as soon as possible, with those metric units that are fast becoming a common part of Canadian life.

Education officials are required to offer leadership in forming implementation strategies related to metric conversion. Business administrators must become familiar with metric terms governing equipment and supplies. Secretaries, custodians, and all support staff will be influenced by metrication, and those who design school buildings must become thoroughly conversant with forthcoming changes in the construction industry. Metric units must be introduced, therefore, not only to students but to everyone in a school system.

Publishers of textbooks and producers of learning materials are expected to use the metric system in all new editions, if at all possible. Should a new text require a list of conversion factors between imperial and metric units, it is recommended that such factors be given in an appendix, not in the main body of the text.

It is now recommended that metrication be given high priority and full support in elementary and secondary schools, and that all administrators and teachers become familiar with common metric units of measure.

2 . . . that metric conversion be implemented in the schools with the express intention of ensuring that programs of instruction become predominantly metric by June 1978

2:1 Meaning of "predominantly metric"

The expression *predominantly metric,* as used in this policy statement, ultimately applies to an individual student's knowledge and use of *common metric units.* In other words, in a predominantly metric program the student, depending on his or her age and ability, is familiar with appropriate common metric units of length, area, volume, mass, and temperature, and uses these units in school for making and expressing measurements in all areas of the curriculum.

In general, we are now predominantly imperial. For example, if a student were asked to state his height, he would say, "Five feet, four inches." In a predominantly metric environment, his answer would be, "One hundred and sixty-three centimetres."

2:2 Common metric units

In this document, the expression *common metric units* refers to those metric units that are most often encountered in daily life.

Attribute	*Unit*	*Symbol*
Length	millimetre	mm
	centimetre	cm
	metre	m
	kilometre	km
Area	square centimetre	cm^2
	square metre	m^2
	hectare	ha
	square kilometre	km^2
Volume	cubic centimetre	cm^3
	cubic metre	m^3
	millilitre	ml
	litre	l (or ℓ)
Mass	gram	g
	kilogram	kg
	tonne	t
Temperature	degree Celsius	°C

The unit of speed, kilometre per hour, with its symbol, km/h, will become familiar to students as they travel on our streets and highways.

2:3 More specialized units

While the expression *predominantly metric* refers only to common units, more specialized units should be included in the curriculum as soon as practicable. An example is the replacement of *cycle per second* by *hertz.* In SI, reference is made to 60 Hz (hertz) rather than 60 cycles per second. Section 4:3 deals with information on the correct units and symbols to be adopted.

2:4 Target date

June 1978, the target date proposed in this policy statement, is the latest date by which the Ministry of Education expects a school to complete the changeover to the use of common metric units. In many schools the transition will have been completed well before June 1978.

This target date has been set in consultation with the other provincial departments of education, with the Federal Metric Commission, and with educational associations and publishers.

2:5 Elementary schools

There are already a few elementary schools whose programs are almost exclusively metric. Others have not yet initiated change. Metrication has, until now, been left to the discretion of each educational jurisdiction. At this time, however, all elementary schools in the province that have not yet begun a metric conversion program are advised to do so in the immediate future; it is recommended that implementation in the classroom commence, at the very latest, by the beginning of 1976. It is assumed that this implementation phase will be preceded by teacher preparation and the acquisition of metric learning materials.

2:6 Secondary schools

All secondary schools that have not yet initiated a metric conversion program are also advised to do so in the near future, especially in view of the fact that time must be allowed for teacher preparation and the acquisition of metric learning materials. Classroom implementation of the changeover to common metric units of length, area, volume, mass, and temperature

should commence, at the very latest, by the fall of 1976 and should be completed, in most applications, by June 1978.

2:7 Peak periods of metrication in the curriculum

It is anticipated that the major part of the metric conversion program in the schools will take place in the following calendar years:

elementary schools – 1975 and 1976
secondary schools – 1976 and 1977

Conversion to the predominant use of common metric units is expected to be completed by June 1978.

2:8 Achieving the intended target

Success in achieving metric conversion by the target date indicated will be influenced by many factors.

The most significant factor is the preparation of education officials and teachers. Metric workshops should be conducted to familiarize them with common metric units. An educator who now thinks in terms of imperial units such as the yard, quart, pound, and degree Fahrenheit must be prepared to use the metre, litre, kilogram, and degree Celsius.

Another important factor governing metric conversion in the schools is the timing of developments that are expected to take place in other sectors of society and that will inevitably affect education. For instance, weather forecasts are expected to include metric units in 1975. This will influence the teaching of Environmental Studies and Geography.

A further variable that will affect metric implementation is the availability of supportive instructional materials that may be required at appropriate stages. Publishers and producers are actively engaged in attempting to meet the demand. With respect to common units, metric conversion can often be implemented through practical exercises outlined on worksheets, or by making changes in existing texts until adequate material is available.

3 . . . that metrication be applicable to all areas of the curriculum and that all measured quantities, wherever appropriate, be stated in metric units

3:1 Co-operative conversion

Since it is policy for all schools to be predominantly metric by mid-1978, it is essential that every area of the curriculum, not just mathematics and science, be affected, and that all teachers accept responsibility for metrication.

The staff of a school must plan co-operatively. When it is agreed that, with students of a certain level, lengths will be expressed in millimetres, centimetres, metres, and kilometres, then these units should also be introduced in art, drama, athletics, science, mathematics, language arts, creative projects, scale drawings, map-making, dressmaking, or wherever linear measurement is used.

3:2 Specialized applications of units

As students advance they meet more specialized units of measure in the various disciplines. For instance, the hectare metre* may turn up in reference to the volume of water in a reservoir. The introduction of such units will require co-ordination by those who plan the curriculum to ensure that there is a sequential order in development from basic to more complex concepts.

The introduction of some metric units may be staggered in different applications to correspond with the timing of metric conversion in various commercial sectors of Canadian life. Weather forecasts, for example, may refer to degrees Celsius, while oven temperatures may, for some time, be stated in degrees Fahrenheit.

It is realized that there are some specialized areas where the cost of equipment is comparatively high, such as in machine technology. Metric conversion in such situations may be delayed beyond the target date, but even in these conditions references to measurements should be metric whenever possible.

*The hectare metre replaces the acre foot. Reservoir volumes are often given as the product of surface area times depth.

As Canada goes metric, imperial units should be phased out without undue procrastination. Some exceptions to the general principle of replacing imperial units are:

a) the use of some non-metric units, such as the minute, hour, and day, which are permitted for use with SI;

b) historical or literary references to imperial or other bygone units;

c) a few cases where some commercial sector may decide to retain an imperial module;

d) references to items based on imperial sizes, which require servicing after metric conversion.

4 . . . that the units and symbols of the metric system to be taught in the schools conform to those of the International System of Units, known as SI

4:1 Metric style

There have been a number of versions of the metric system. This has resulted in a diversity of practices in different countries and among different branches of science. The kilogram, for example, has been used to measure entirely different attributes, and its short form has been shown as Kgm, Kg, kg, kgm, as well as a number of other variations. From a global perspective, this has produced unnecessary confusion.

There is now a unique international style to be used when expressing metric measures. This style is set forth in SI, and it is this practice that is to be introduced in the schools as metric conversion takes place.

4:2 SI

In 1960 the General Conference of Weights and Measures, of which Canada is a member, established the modernized metric system, called the International System of Units, or simply SI, from the French *Système International d'Unités.*

One purpose behind the promotion of SI has been to encourage a universal language of measurement. In SI, metric symbols are specified precisely and are the same for all nations.

Canada is converting to SI. It is, therefore, the policy of the Ministry of Education that SI is to be taught in the schools of Ontario.

In this context, SI refers to the International System of Units and a few other units that are permitted for use with SI.

4:3 Metric Style Guide

The Council of Ministers of Education, Canada, commissioned the preparation of a document for elementary and secondary school teachers, outlining the correct style to be used when expressing metric measures. This document, called the *Metric Style Guide,* is a reference book on modern metric terminology and symbolism. It does not deal with teaching techniques.

The Style Guide has been approved by the Metric Commission as being in conformity with preferred practice in Canada. It is authorized by the Ontario Ministry of Education for use in all schools of the province. A copy will be made available to each teacher (in English or French).

5 . . . that metric conversion be accepted as an opportunity to reassess pedagogical approaches toward the topic of measurement as a whole; that students be provided with opportunities to acquire a practical and experiential knowledge of metric units through activities that involve comparing, estimating, measuring, and related problem-solving; and that teachers and students be encouraged to design and construct appropriate measuring devices to be used in conjunction with selected commercial equipment

5:1 Experiencing metric units

Metric conversion in Canada is causing many sectors to reassess the role of measurement. The changeover presents a unique opportunity for teachers to examine pedagogical approaches to the entire topic of measurement.

Since measurement is an active process, it is essential that students measure – measure all kinds of attributes such as length, area, volume, mass, temperature, speed, force, energy, power, frequency, density, and many more, as may be appropriate in the experience of the student.

Students can be encouraged to see, feel, sense, or experience such units or quantities as a metre and a kilometre, a gram and a kilogram, a litre and a cubic metre, a square centimetre and a hectare, some temperatures in degrees Celsius, a newton force, and a joule of work.

Through such concrete understandings, these units become realistic in the experience of the learner. It is meaningless, for instance, to refer to so many hectares of land when a student has no real visualization of the size of a hectare.

A student should be able to think naturally in metric terms. He or she should be able to estimate in various metric units and then check his or her guess by careful measurement.

An important part of the study of measurement is problem-solving – problems that are practical and relevant, and often based on the actual measurements made by the student.

While it is desirable to teach the metric system, it is also essential to cover the broader topic of measurement. When a new type of measure, such as length, area, mass or force, is introduced, it is advisable to initially ignore metric units. The student should be allowed to measure with non-standard units, particularly of his or her own choice. Later he or she can see the need for standard units and, in particular, the advantages of metric units.

5:2 Measurement requires equipment

Rulers, measuring jugs, balances, and thermometers are as essential to learning measurement as a car is to driver education. Measurement is learned by measuring. Therefore, it is essential that measuring devices be made available to facilitate the learning of the metric system. This means careful consideration of teaching techniques, financial resources, and the most appropriate kinds of measuring devices.

The Ministry of Education will subsidize part of the cost of metric conversion in the schools. It is policy, however, that school boards shall bear a sizable portion of the financial responsibility.

The Ministry will indicate the extent of the legislative grants to be allotted to school boards for metrication.

It is hoped that some of the sections in the remainder of this document will, to some extent, be of assistance in guiding administrators in matters related to the costs of metric conversion.

5:3 Kinds of measuring devices

Measuring devices can be (a) produced commercially, (b) constructed by educators, or (c) made by students.

None of these methods should be adopted to the exclusion of the others; not all items should be purchased, nor should they all be made by the students.

Consideration must be given to:
a) the costs of commercial equipment, construction materials, and tools;
b) the amount of time required by teachers for planning, designing, ordering, and constructing;

c) the amount of time available in class to teach and learn a given concept;
d) the value of the learning experience gained when students construct some of their own measuring devices;
e) the suitability of the measuring device for a given learning objective;
f) the adaptability of the device to a variety of applications – for example, interlocking centimetre cubes can be used in the teaching of length, area, volume, mass, colour, sets, number stories, models of numeration systems, etc.;
g) the durability of the device;
h) the accuracy of the device;
i) safety features, such as the absence of sharp edges;
j) copyright and patent regulations.

5:4 Constructing measuring devices

Any of the following can be constructed by students: metre sticks, measuring tapes, rulers, litre boxes and cubes, measuring jugs, balances, standard metric masses, and simple timing devices.

The major consideration to be given to student-made equipment is the learning experience. This may involve planning, designing, calculating, drawing plans, choosing materials, following instructions, using tools, applying adhesives and finishes, and calibrating the devices. The sense of accomplishment and ownership is beneficial. Ultimately, time and money may be saved or they may not, but the learning experience must be effective and well worthwhile.

5:5 Equipment lists

There is no single list of measuring devices that must be adopted by a school for the teaching of common units in the metric system. The following list is given for consideration only; it must not be viewed as authoritative or mandatory. Its purpose is to provoke thoughtful debate on such questions as:
– Is each item necessary?
– What priority should each item have in our school?
– Would it be beneficial to have some items made by the school board, some by teachers, some by students?
– Should some items be centrally located in the school, and others in specified classrooms?
– How many items does each class need?

– How can we best utilize available funds in purchasing equipment?
– How can the equipment be made readily accessible to the students?

a) High priority
metre sticks
rulers
measuring tapes (100 cm or 150 cm)
longer tapes (5 m or 10 m)
trundle wheels
printed adhesive tape (showing cm and/or mm)
transparent grids showing centimetre squares
volume sets of containers
graduated cylinders
litre boxes or cubes
packages of interlocking centimetre cubes
balances (double pan)
sets of metric masses (metal and/or plastic)
personal scales (bathroom type) graduated in kilograms
graph paper with centimetre squares
Celsius thermometers for student use
clocks (with seconds hand) – already in many classrooms
metric measuring cups and spoons

b) Moderate priority
balances (single pan, dial type)
volume sets (with different shapes than choice made above)
long tapes (50 m)
height measures
wall thermometers
timing devices such as a seconds pendulum
spring balances graduated in grams and kilograms

c) Low priority
clinical thermometers
cubic metre frame
cuboid capacity set
demonstration 24-hour clock
demonstration calipers
spring balances graduated in newtons

5:6 General suggestions regarding equipment

These suggestions apply particularly to the use of measuring devices required for the teaching of common metric units.

– Plan well in advance and consider all aspects of the use of measuring equipment.
– Give students some opportunity to design and construct their own equipment. Do not buy everything; do not make everything.
– Find out what budget is available and order with care. Prices differ with different companies. Multi-purpose items of good quality are worth consideration.
– Search for metric equipment that is already in the school system. Perhaps science departments have a lending policy.
– Consider the advisability of converting old equipment on a tentative basis. For example, foot rulers can be covered with graduated metric adhesive tape.
– Ensure that symbols on new measuring equipment conform with SI practice. Do not throw out "old" metric supplies soley because of non-conformity; gradually replace them through attrition.
– Watch for clarity in the marking of numbered scales on rulers, graduated containers, standard masses, balances, thermometers, etc.
– High-accuracy calibration, if resulting in costly equipment, is generally not justified.
– Improvise, where feasible, to save money, and often to improve the learning experience.
– Do not phase out all imperial equipment suddenly. Metric conversion in the community will take several years and some imperial items will have historical and interest value.
– Consider the kinds of subdivisions needed on a measuring device for a particular learning experience. A metre stick, marked in decimetres, centimetres, and millimetres, all on one scale, may be confusing to some students, but helpful to others.
– Do not adhere to another person's equipment list without considering *your* students' particular needs.

6 . . . that metric changes in the curriculum be co-ordinated with corresponding changes in industry and commerce

6:1 Applications of conversion

In teaching the metric system, the teacher will naturally seek relevant examples with which to illustrate the use of common measures. In the next few years there is every likelihood that metric conversion will change weather forecasts, highway signs, food packaging, calorie counters, height charts, gasoline pumps, shirt sizes, kitchen recipes, tourist brochures, utility billing, bottle capacities, athletic events, and construction modules – so that there will be no shortage of familiar applications from which examples may be drawn.

When it comes to particular applications of the use of metric units, however, care must be taken to prevent misconceptions. For example, there has been some debate over the size that should be used for a measuring cup. Some want a 250 ml cup, some 200 ml, while others see no need for a "cup" as a measure and want recipe volumes stated in millilitres and measured in graduated jugs. At present this issue is not resolved, but it serves to point out that teachers must be careful not to presuppose decisions that are yet to be made in certain commercial sectors.

Toothpaste has already "gone metric" and is available in 25, 50, 75, 100, and 150 ml tubes, so it is safe to refer to these sizes. Where standard sizes have not been finalized, predictions, if any, should be made with caution. It is not the business of education to tell other sectors what sizes they will use.

6:2 Soft and hard conversions

A "soft conversion" to the metric system occurs when the size of a commodity is not changed but its size is stated in metric units rather than imperial units. Only the label changes. For example, the label of a bottle of skin lotion marketed in a 10 fl. oz. size is changed to indicate a volume of 284 ml. Both metric and imperial specifications may appear on the label.

A "hard conversion" occurs when the actual size of the commodity is changed. The new size is generally based on a convenient number of metric units. The 10 fl. oz., or 284 ml, bottle of skin

lotion would probably be replaced by a new 300 ml bottle. The imperial equivalent of the new size (10.56 fl. oz.) may also be shown, but eventually will become unnecessary. As a rule, when hard conversions are made, there is an attempt to reduce the overall number of sizes and still provide for our various needs.

Many products in our stores now show soft conversions. However, the number of hard conversions is increasing rapidly. It is hoped that such changes will be noted for instructional use.

6:3 When to change

There are already numerous applications of common metric units in various sectors of Canadian society. Therefore, there is good reason to teach the metric system now, particularly as it applies to everyday situations.

Changes in more specialized fields can be mentioned in the classroom, but such changes are better stressed just prior to actual implementation. For example, the barometer reading in weather reports is presently stated in inches of mercury. In 1976 this will probably be expressed in metric units. At present, it seems unlikely that millimetres of mercury will be used. Perhaps millibars, hectopascals, or kilopascals will be adopted. Final usage has not been settled. As the time for change approaches, more information will be available and we will know what units to use.

In such cases of specialized application, it is suggested that changes in the curriculum be co-ordinated with corresponding changes in industry and commerce. It may be as detrimental to leap too far ahead as to lag too far behind.

The Ministry will attempt to keep schools informed regarding applications where the use of specified metric units has been formally approved.

7 . . . that metric conversion of learning materials in the schools be carried out on a pre-planned and gradual basis, with due consideration being given to the attrition, modification, and replacement of materials as well as to the availability of new learning materials.

7:1 The phasing-out of imperial items

Many types of instructional materials, ranging from an inexpensive ruler to a costly milling machine, will appear outdated due to metric conversion within a few years. Exactly how many years is subject to many variables. Imperial items will have to be replaced by metric ones gradually, not all at once.

Some items can be phased out under normal operational expenditures. An example might be rulers purchased by the school board. Over a period of two or three years, it will not be a costly procedure to phase out all imperial rulers – perhaps in the Primary Division first, then Junior, and so on – and replace them with those showing metric graduations only. Hence, normal attrition can account for some changes. Minor expenses may be incurred to get the conversion process completed in a reasonable time, but such cost should be relatively low.

Some items can be modified rather than replaced. For example, many metal lathes can be converted to metric operation with the aid of a conversion kit. Of course, any new machinery purchased should be metric, where applicable.

If an expensive machine cannot be converted, students will have to work from metric drawings, use a conversion table and calculator, set the machine to the equivalent imperial operation, and in this way produce the part as required in the drawing. The machine could eventually be phased out when funds become available.

Attrition and modification should always be considered before resorting to replacement. For example, Fahrenheit wall thermometers can be tentatively changed to Celsius by means of carefully marked adhesive tape. The teaching of common metric measures should be in full operation by mid-1978, although all specialized equipment will not necessarily be converted by that time.

7:2 The spirit of change

In spite of ingenious modifications and creative thinking, metrication will inevitably create expense and some frustration. The answers to many questions cannot yet be given. However, the Ministry expects school boards to plan carefully and to gradually phase out imperial usage, keeping in mind that many low-cost changes can be made over a period of several years.

Metrication presents a considerable challenge. It is expected, however, that all educators will implement the changeover in a spirit of positive co-operation.

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